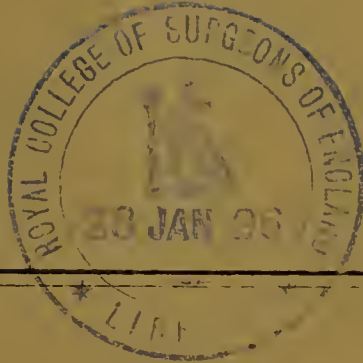

The Results
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The Results of a Year's Experience in the Surgical Treatment of Hydrocephalus in Children.

CLINICAL LECTURE DELIVERED AT THE VICTORIA HOSPITAL FOR
CHILDREN.

By D'ARCY POWER, M.A., M.B. (OXON.), F.R.C.S. (ENG.),
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THE RESULTS OF A YEAR'S EXPERIENCE IN THE SURGICAL TREATMENT OF HYDROCEPHALUS IN CHILDREN.

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BY D'ARCY POWER, M.A., M.B. (Oxon.), F.R.C.S. (Eng.),

Surgeon to the Victoria Hospital for Children, Chelsea.

GENTLEMEN,—Hydrocephalus, like ascites, is one of the medical terms which has been handed down to us from classical times. It is a symptom, and often an important symptom, of a variety of pathological conditions, and with the advance of pathological science it is gradually disappearing from the nomenclature of the scientific practitioner. Hydrocephalus as it is seen in children, with whom alone this paper deals, occurs in a simple form, including the majority of the congenital and chronic cases, and in an infective form comprising nearly all the acute and subacute cases. Hydrocephalus in its widest sense is an increased secretion of cerebro-spinal fluid, either into the ventricles of the brain alone, more rarely into the subarachnoid space alone, or, as most often happens, into both the subarachnoid space and the ventricles of the brain. The effusion is either slow and passive, or it is rapid and due to irritation. It is always serous, though it is often associated with plastic deposits.

Little or nothing is known of the pathology of the congenital form. It may be associated with other developmental errors, either of the body generally or of the cerebro-spinal system in particular. Our knowledge is not advanced, however, by saying that it is due to a dropsy of the ependyma, and we know that it is only occasionally associated with closure of the foramen of Magendie or the point of communication between the intracerebral cavities and the subarachnoid space of the spinal cord. Chronic hydrocephalus may occur in connection with rickets, and it is sometimes, but much more rarely, a manifestation of congenital syphilis. The acute forms of hydrocephalus are so often tuberculous that the correct pathological term, tubercu-

lous meningitis, has replaced in the minds of many physicians the older and more vague one of internal hydrocephalus. Papavoine,¹ working in Guersent's clinic, first drew attention to the coexistence of this form of tubercle with effusion from the cerebral meninges,—a correlation still further insisted upon by Dr. Gerhard² in America, and a few years later by Dr. P. Hennis Green³ in this country. The statement, however, is a little too general. Every case of acute hydrocephalus must not be attributed to tubercle, though the majority are undoubtedly due to this cause; for the effusion of cerebro-spinal fluid may result from any source of irritation acting upon the cerebral meninges and their extensions into the brain. Many such causes of non-tuberculous meningitis with serous effusion are now recognized, and even they are not all of an infective nature. It is met with after pneumonia in children, and more rarely after influenza, but I have seen it result from the growth of a cyst in one of the choroid plexuses, whilst subacute forms are sometimes associated with a sarcomatous growth.

Hydrocephalus, whatever its cause and however it occurs, is always a most troublesome, and is often a most dangerous, condition in children. Every surgeon to a children's hospital is constantly called upon to treat these cases, and you know that we have been no exception to the rule in the Victoria Hospital. Our wards nearly always contain one child affected with meningitis, and there is often more than one. Our physicians, disheartened by the great mortality attending these cases, are more and more ready to hand the patients over to their surgical colleagues. We get them now at an earlier period in the disease than we did before Mr. Waterhouse obtained his successful result by trephining and draining the subarachnoid space.⁴

I contented myself formerly with letting these cases alone, only trying simple surgical measures, for I was guided by Henoch's dictum that little or no good was done by operation; then I tapped the ventricles, but latterly I have trephined and drained them. I was mainly induced to resort to this method of treatment by Professor Keen's valuable paper upon the surgery of the lateral ventricles, which he has so cunningly concealed in an unindexed volume of the Transactions of the Tenth International Congress held at Berlin in 1890, and by

¹ Journ. hebdom. de Méd., Paris, 1830, p. 113.

² American Journal of the Med. Sci., Phila., 1833-34, vol. xiii. p. 313, and vol. xiv. p. 99.

³ The Lancet, 1835-36, vol. ii. p. 232.

⁴ Trans. Med. Soc. of London, 1894, vol. xvii. p. 237.

Broca's work in the same direction, as well as by the excellent work of my friend Dr. C. A. Morton, and of Dr. Parkin. I bring before you now a *résumé* of the various cases I have treated during the last year, without any selection, but it is important that, as far as possible, every case should be recorded when a new method of surgical procedure is upon its trial.

CASE I.—T. W., aged two and a half years, was admitted into the Victoria Hospital on March 1, 1894, for hydrocephalus. He had the following interesting family history: "Two of his mother's brothers have such large heads that their hats have to be made specially for them. The elder of the two brothers had 'fits' until he was seven years old. There have been eleven children in the family. The eldest, a boy, died in the Evelina Hospital from hydrocephalus at the age of twenty-one months. The second child, also a boy, died shortly after his delivery by forceps. The bones of the skull in the third child, a girl, were so imperfectly developed that they could be squeezed in like stiff brown paper. She died when she was five months old.

"The fourth and fifth children were twins; one had hydrocephalus, both had 'fits,' and both died when they were six weeks old. The sixth child is alive and healthy; he is a boy. The seventh child had a very large head. He lived six weeks, and had two hundred 'fits.' The eighth is a boy aged five, alive and well. The ninth was a boy, who died at the age of five weeks; his head was normal. The tenth is the present patient. The eleventh is nine months old, and is healthy."

T. W.'s head measured sixteen inches in circumference at birth. It now measures twenty-two inches. He is fairly intelligent, but has been very slow in cutting his teeth. He had repeated "fits" from the time he was six weeks old until the age of two years. He has attacks of spasmodic cough, and he screams at night. His head is typically hydrocephalic, and the anterior fontanelle is as large as a florin,—i.e., measures twenty-nine millimetres across,—whilst the posterior one is closed. The anterior fontanelle is not tense, and it only bulges when the child cries. The patient is strong and well nourished. He is not paralyzed, but he is restless, very fretful, and is markedly hyperæsthetic.

Four days after his admission I punctured his right lateral ventricle with a trocar and cannula, drawing off half an ounce of blood-stained cerebro-spinal fluid. The operation was performed aseptically under chloroform. It was followed by a little rigidity of the left arm, which soon passed off. A collodion dressing was applied to the puncture,

and a firm bandage was put on. On March 8, four days later, the note records that "the boy seems decidedly better for the operation. He is bright, happy, and has lost much of his hyperæsthesia." He was discharged from the hospital a few days later, and was readmitted on April 25. His mother volunteered the statement that since he has been at home he has sat up much better, and has appeared to take more notice of things; latterly, however, he has again become hyperæsthetic. His head now measures twenty and seven-eighths inches in circumference. The left lateral ventricle was first punctured, but only a few drops of cerebro-spinal fluid were obtained. The trocar and canula were therefore driven into the right ventricle through the edge of the anterior fontanelle. Two ounces and a half of cerebro-spinal fluid spurted out with considerable force as soon as the trocar was removed from the canula. The fluid was quite clear; it did not contain any albumen or copper-reducing substance, but chlorides were very abundant. The temperature remained normal, and the patient was sent home two days later. He was brought to the hospital again on June 28, as he had been fretful for the last fortnight and was continually sighing. He had not been convulsed, nor had he squinted, and there was no rigidity, but he was hyperæsthetic and very irritable. His head measured twenty and three-quarters inches in circumference. A trocar and canula were put into each ventricle upon July 6; no fluid was obtained from the left side, but two ounces of blood-stained cerebro-spinal fluid came from the right ventricle. An attempt was again made to draw off fluid upon July 12, but it was unsuccessful, and the child was sent home on the 14th of July, 1894.

I show him to you to-day, May 27, 1895. His anterior fontanelle is almost closed, and his head measures only the same as it did last year. He is able to stand and can crawl readily. He appears to be in excellent health, though his mother says that he had an attack of influenza in the winter, and that he still screams at night, and sometimes has spasmodic cough, but he has no "fits." He is playful and takes much notice of things, but he cannot yet talk, though he is nearly four years old.

CASE II.—W. M., aged four, had been ailing for some weeks, and had been under medical supervision from September 26, 1893. Dr. Hawkes asked me to see him in consultation on October 5. It was obvious that he was suffering from an attack of tuberculous meningitis, and it was agreed that he should be trephined, and that his ventricles should be explored, and, if necessary, drained. On October 6 he had Cheyne-Stokes breathing. There was no marked rigidity; his pulse

was rapid and soft; his temperature was 101.6° F. Chloroform was administered, as the boy was not insensible to pain. A semicircular flap of skin and pericranium was turned down, and a crown of bone was removed with a three-quarter-inch trephine from a point just behind and a little above the right ear. The dura mater at once bulged into the opening; its vessels were much congested, but the brain beneath did not pulsate. The membranes were therefore incised, and a grooved director was passed inward through the cerebral substance in the direction of a corresponding point on the opposite side of the skull. Two ounces of clear cerebro-spinal fluid escaped. A small drainage-tube was passed into the ventricle, and the flap was replaced and stitched up in such a manner as to leave the end of the tube projecting at the wound. The condition of the patient was improved by the operation, inasmuch as his breathing became regular; his pulse distinctly increased in strength; he had much less twitching of his muscles, and he took milk and Valentine's meat-juice more readily. This improvement was maintained for ten hours after the operation; his breathing then became irregular, the twitching of his left arm and of his facial muscles recommenced, and his temperature began to rise. Typical Cheyne-Stokes breathing returned about three hours after the reappearance of the pressure-symptoms, and the patient died twenty-seven hours after he had been trephined. We were unable to obtain an autopsy, but the wound was perfectly aseptic.

CASE III.—T. H., aged four, was admitted into the Victoria Hospital on March 14, 1894. The diagnosis of his condition lay between meningitis with serous effusion and suppurative meningitis. There was no history of tubercle, but the child had suffered from otorrhœa all his life. The discharge ceased two months before the patient's admission to the hospital, and shortly afterwards he began to complain of pain in his head. The cerebellum was exposed by trephining upon the left side; clear cerebro-spinal fluid escaped, but, as no abscess could be detected, a second crown of bone was removed to allow of the exploration of the temporo-sphenoidal lobe. The boy improved a little after being put back to bed, for the coma was less absolute and the pulse became regular. The temperature, which for some days before the operation was about 101° F., sank to 97° F., and remained at normal until death. The note records that on the day following the operation the slight improvement was maintained. The food was taken better; the respirations were grouped, but they were not true Cheyne-Stokes, for they did not vary in depth. Death took place on the 23d inst., two days after the operation. The post-mortem examination

showed that the case was one of tubercular meningitis, and that the brain had not suffered from the surgeon's manipulation.

CASE IV.—H. R., aged five, admitted into the Victoria Hospital April 23, 1894, suffering from tuberculous meningitis. The child became progressively worse until April 30, when it was quite unconscious and appeared to be moribund. The boy was trephined, and half an ounce of fluid was let out from the subarachnoid space. He lived until May 5, his temperature steadily ascending the whole time. The operation did not appear to make the smallest difference in his condition, either for good or for bad.

The post-mortem notes record that he had tubercles in his lungs and caseous nodules in his bronchial glands. There was a trephine hole in his right cerebellar fossa, the skin wound being almost healed, except at the point where the drainage-tube was inserted. There was no suppuration, but there was a plastic deposit covering the base of the brain. The convolutions of the brain were flattened, and the ventricles contained three or four ounces of clear fluid.

CASE V.—A. F., aged two and a half years, admitted into the Victoria Hospital on July 19, 1894. He followed the usual course of a patient with tuberculous meningitis, and on July 26 he was squinting and was unconscious. I trephined his skull low down in the occipital region and immediately to the left of the middle line. There was little or no fluid in the subarachnoid space. The note records that on the following day the condition of the patient is much the same, but the coma is somewhat less profound. The temperature, however, fell steadily after the operation until just before death on the 31st inst., when it suddenly began to rise.

CASE VI.—A. C., aged six months. The child was strong and healthy till it was seven weeks old. It then had a rigor, was convulsed, and remained unconscious for three days. Its head has been slowly enlarging ever since. The child was anæsthetized on April 23, and I drew off five ounces of blood-stained cerebro-spinal fluid from its left lateral ventricle by puncturing the brain through the anterior fontanelle. The pulse improved in volume and in strength directly the fluid was removed. The head was then strapped and tightly bandaged to keep up pressure. The condition of the child was said to be improved upon the following day, for the ward note says, "He does not vomit so often, and he takes his food better. There is less twitching of the arms and legs." There was more rigidity on May 5, and the circumference of the head had increased from eighteen and three-quarters inches on April 22 to nineteen inches. There is still some

sickness. The child was restless, and there was more bulging of the fontanelles and sutures. The head was retracted and opisthotonus was becoming marked. I therefore trephined the skull over the descending horn of the right lateral ventricle, and removed five ounces of clear cerebro-spinal fluid by pushing a trocar and canula through the dura mater. Drainage of the ventricle was carried out by means of a dozen horse-hairs bound together and passed along the track of the canula into the ventricle. The child had a little rigidity of the left side after the fluid had been drawn off, but it passed away before he was removed from the operating-table.

The ward note states that the child was distinctly improved by the operation, but on May 8 the symptoms of cerebral pressure again became pronounced and the temperature began to rise. I dressed the wound, and found that the horse-hair drain had nearly disappeared beneath the skin-flap, and that no cerebro-spinal fluid was escaping. I therefore readjusted the bundle of horse-hairs and satisfied myself that it was effective. The ward note says, "May 10, the child has been better since the wound was dressed on the 8th inst., and there has been so free a discharge of clear cerebro-spinal fluid that a daily dressing is required. The temperature is lower, there is less sickness, and the child takes food better. The wound has healed, except at the place where the drain lies, and the sutures have therefore been removed. May 12. There is still good drainage. The temperature is lower, and the general condition is distinctly better. There is less retraction of the head, and the opisthotonus is less marked. The child cries out less, and does not resent being disturbed so much."

The previous symptoms of intracranial pressure recurred upon the evening of the 12th, and the temperature rose to 103.4° F. No fluid had passed along the horse-hair drain since the previous evening. I therefore opened up the subarachnoid space about an inch and a half below the occipital protuberance and as near the middle line as it was safe to go. A drainage-tube was passed into the subarachnoid space, and was brought out through a hole in the centre of the flap. There was a free flow of cerebro-spinal fluid, and the temperature dropped from 104.6° F. to 98° F. It remained low for two days, whilst there was a free discharge of fluid, but on the 16th it rose to 101° F. The tube was explored with a probe, and by exercising a little gentle pressure upon the skull a free discharge of fluid was again obtained. The temperature immediately fell, and remained low until it rose again to 103.4° F. just before the child's death on the 20th.

The autopsy in this case showed that there was neither tubercle,

syphilis, nor rickets. I examined the cerebro-spinal fluid carefully for bacilli, but I could find none. I injected some of it intraperitoneally into a guinea-pig, but there was no reaction. The cause of the condition is therefore obscure. The brain was found to be thin and expanded; the subarachnoid space contained about two ounces of clear cerebro-spinal fluid, the ventricles a little more, and more upon the left side than upon the right. The piece of drainage-tube had passed forward and downward beneath the cerebellum until it lay upon the floor of the fourth ventricle in such a manner as to leave a track along the inferior surface of the left lobe of the cerebellum. Its point lay exactly opposite the foramen of Magendie, which was large enough to admit a No. 4 catheter. The arachnoid at the base of the brain was thickened, but it did not present any tuberculous nodules. It was distended into a sac containing clear cerebro-spinal fluid, and lying on the under surface and at the posterior edge of the cerebellar hemispheres.

The results arrived at in these cases are not very encouraging, but they are, I think, sufficiently hopeful to lead us to persevere in operating, at any rate in some cases of hydrocephalus. I hold very strongly, with Professor Jacobi, that the motto of every surgeon should be *non nocere*. No harm has been done in any of the cases, and it was manifest to us, who were watching the cases, that in each instance the life of the child was prolonged, sometimes only for a few hours, sometimes for a few days, and sometimes even for a longer period. I say this advisedly, well knowing how rapid and how startling are the changes which take place in the more acute cases of serous meningitis with effusion. The removing of the fluid, by relieving the intracranial pressure, led in each case to an improvement in the pulse and in the respiration, whilst the fall of temperature was so great and so marked in several instances that I am beginning to wonder whether the temperature can be looked upon as an index of the amount of intracranial pressure. It is, at any rate, a point which I shall bear in mind in future cases, for the few observations I have made are insufficient to settle so important a question.

It is obvious that in tuberculous cases the same good results are not obtained by letting out the fluid as occur after laparotomy for the relief of tuberculous peritonitis. This is perhaps due to the fact that the cerebro-spinal fluid is a better culture medium than the peritoneal fluid. It is in these cases, however, and in those associated with the growth of other micro-organisms that we should hope to obtain the

best results by trephining and draining; for in these cases the onset is acute, the effusion is not very great, and the brain substance is comparatively little thinned, whilst it is only in the later stages that it is paralyzed by pressure. It is necessary, however, in these cases that there should be no active centre of disease to produce and disseminate bacilli; for so long as such a central focus exists, so long must local peripheral resistance be useless. Neither can we hope to obtain any satisfactory results so long as the base of the brain is covered with a thick layer of inflammatory exudation. The post-mortem appearances in the chronic and congenital cases warn us that any operative measures in the direction of draining away the cerebro-spinal fluid must be adopted early, and must of necessity be useless in congenital cases. The cerebral substance is so thin and is so greatly disorganized in cases of long-standing intraventricular effusion that it is as hopeless to expect a good result in them as it would be to look for recovery of function after draining a congenital cystic kidney.

There remain, then, only a small minority of cases of hydrocephalus in which drainage is likely to be of service. Such cases are those in which the effusion comes on slowly, as in Case I., without any assignable cause; and in these cases it would appear as if simple puncture were sometimes sufficient to effect a cure. Secondly, those cases in which the effusion is due to the action of micro-organisms which have no chemotactic properties,—that is to say, have no power of causing plastic deposits by leading to an increased exudation of leucocytes. We are as yet unable to diagnose such cases, but, inasmuch as they certainly occur, we are justified in operating in those cases of meningitis with effusion which have not already progressed too far. We may save life; we shall certainly not destroy it, for the operation *per se* is not dangerous.

